The WheatCAP Project Delivers Genomic Resources For Improved Wheat Breeding

Marcelo A. Soria\textsuperscript{1}, Jamie Sherman\textsuperscript{21}, Jim A. Anderson\textsuperscript{2}, P. Stephen Baenziger\textsuperscript{3}, Guihua Bai\textsuperscript{11}, Bill Berzonsky\textsuperscript{4}, Gina Brown-Guedira\textsuperscript{5}, Kim Campbell\textsuperscript{6}, Brett F. Carver\textsuperscript{7}, Jorge Dubcovsky\textsuperscript{1}, Allan Fritz\textsuperscript{9}, Carl A. Griffee\textsuperscript{10}, Scott D. Haley\textsuperscript{12}, Jerry W. Johnson\textsuperscript{13}, Shahryar F. Kianian\textsuperscript{14}, Kimberlee K. Kidwell\textsuperscript{15}, Dave E. Matthews\textsuperscript{25}, Mohamed Merroun\textsuperscript{16}, Herbert Ohm\textsuperscript{17}, Jim Peterson\textsuperscript{18}, Oscar Riera Lizarazu\textsuperscript{19}, Jackie Rudd\textsuperscript{20}, Luther Talbert\textsuperscript{21}, Shiaoman Chao\textsuperscript{8}, Mark E. Sorrells\textsuperscript{22}, Edward Souza\textsuperscript{23}, Robert Zemetra\textsuperscript{24}

1 Department of Plant Sciences, Mail stop 1, University of California Davis, One Shields Ave. Davis, CA 95616-8515
2 411 Bolza Hall, Department of Agronomy and Plant Genetics, University of Minnesota, Twin Cities, St. Paul, MN 55105-6026
3 330 Kern Hall, Department of Agronomy and Horticulture, University of Nebraska Lincoln, P. O. Box 830910, Lincoln, NE 68583-0915
4 Lofsgard Hall 370G, Department of Plant Sciences, North Dakota State University, Fargo, ND 58105-5051
5 Room 5150, BOX 7258, Plant Science Research Unit, USDA/ARS, Raleigh, NC 27696
6 370 Johnson Hall, USDA/ARS Wheat Genetics, Quality, Physiology & Disease Research Unit, Washington State University, Pullman, WA 99164-8420
7 389 Agricultural Hall, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078-0238
8 USDA ARS Biosciences Research Lab, 1508 Albrecht Blvd, Fargo, ND 58105-5674
9 4012 Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS 66506
10 Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, VA 24061-4040
11 4008 Throckmorton Hall, USDA/ARS/PSERU/ Dept of Agronomy, Kansas State University, Manhattan, KS 66506
12 Soil and Crop Sciences Department, C-136 Plant Science Building, Colorado State University, Fort Collins, CO 80523
13 1109 Experiment Street, College of Agricultural and Environment Sciences, The University of Georgia, Griffin, GA 30223
14 4706 Lofsgard Hall, Wheat Germplasm Enhancement Project, Department of Plant Sciences, North Dakota State University, Fargo, ND 58105
15 381 Johnson Hall, Department of Crop and Soil Sciences, Washington State University, PO Box 646420, Pullman, WA 99164-6420
16 Lofsgard Hall 270C, Department of Plant Sciences, North Dakota State University, Fargo, ND 58105-5061
17 1150 Lilly Hall, Department of Agronomy, Purdue University, West Lafayette, IN 47907-1150
18 Department of Crop and Soil Science, 231 Crop Science Building, Oregon State University, Corvallis, OR 97331
19 Department of Crop and Soil Science, 109 Crop Science Building, Oregon State University, Corvallis, OR 97331
20 Texas A&M University System Agricultural Research and Extension Center, 6500 Amarillo Blvd. West, Amarillo, TX 79106
21 Leon Johnson Hall, Department of Plant Sciences and Plant Pathology, Montana State University, Bozeman, Bozeman, MT 59717-3150
22 240 Emerson Hall, Department of Plant Breeding & Genetics, Cornell University, Ithaca, NY 14853-1902
23 USDA/ARS Soft Wheat Quality Laboratory, 1600 Madison Ave, Wooster, OH 44691
24 AG Science 313A, University of Idaho Campus, Moscow, ID 83844-2339
25 Department of Plant and Soil Sciences, Cornell University, Ithaca NY 14853-1902

The design and deployment of new technologies is vital to maintain the competitiveness of the US wheat industry. In 2005, USDA-CSREES-NRI awarded a grant to the WheatCAP consortium to develop new genomic tools and knowledge to accelerate wheat breeding. Breeders from the major wheat-growing states and the four USDA-ARS small grains genotyping centers participate in the project. 

The consortium is applying marker assisted selection (MAS) strategies to improve many traits, with a focus on disease and pest resistances (rusts, fusarium head blight and Hessian fly, among others) and quality (particularly baking, grain protein content, color and texture and gluten strength). In 2008, 210,000 MAS analyses were performed and participating breeders released 29 varieties and germplasm lines applying MAS. Collaborators are also developing longer-term public resources by mapping 19 populations, with an average of 413 markers per map. These populations are being phenotypically evaluated at an average of seven environments for QTL discovery related to complex traits. Single nucleotide polymorphisms (SNPs) were screened in the parent lines and 359 SNPs are being incorporated into the genetic maps. The WheatCAP project carries out an intensive extension and education effort. During 2008 almost 100 high-school, undergraduate and graduate students received training. Participants organized educational trips, lectures and hands-on workshops. More than 50 field days and 60 presentations were delivered to growers and industry. The project web site (maswheat.ucdavis.edu) hosts MAS and general laboratory protocols and educational documents and animations.